DESCRIPTION

"Quick-coupling device for tools on diggers or similar machines"

Technical field of the invention

The invention refers to a quick and reversible coupling device for tools such as shovels, buckets, hammers, clamps, grippers, etc., on machines, especially agricultural, transport, lifting and earth-moving machines such as diggers, back-diggers or similar.

Background of the invention

Various quick replacement or coupling devices currently exist for tools on machines used to move earth. Said devices comprise a first body with coupling elements, such as fixed claws, which clamp onto master pins or coupling axles on a second body, which is separate from the tool which is to be coupled to the machine.

Some embodiments of known coupling devices also use secondary movable coupling mechanisms. This is the case, for example, in patents ES 2102548 and WO 95/16831.

ES 2102548 describes a quick-coupling device in which the movable elements of the first body are two locking shafts, which are essentially cylindrical, and the free ends of these are in the shape of a truncated cone, the angle of the cone matching that of the openings on the locking plate of the second body, which is separate from the tool, and also said locking plate is sloped, on its rear part, which fits the corresponding slope of the contact surface of the first body, thus helping the contact surfaces of the first and second bodies to lock together.

WO 95/16831 has a coupling device also made up of two bodies, the first of these being separate from the tool and the second being separate from an articulated arm of the machinery. In the embodiment, as well as having a coupling axle in one of the two bodies and claws for grasping the coupling axle on the other body, the device has a movable element on one of the bodies, which is wedge-shaped, which operates in conjunction with a fixed element on the other body working in the form of a hook, in such a way that in the coupling position, the wedge moves beneath the hook under the action of a piston or similar.

Due to the heavy-duty work the tools used are subjected to in this type of machinery, the coupling devices known suffer a high level of wear and tear for which the coupling devices, or one of their parts, have to be changed or replaced fre-

quently, and the machines must be stopped to carry out any change required to avoid the possible breakdown or breakage of the parts which suffer the most wear. The use of said devices therefore makes them more costly than desired and the maintenance required is very expensive.

The wear and tear suffered on the devices is caused especially by the concentration of loads on small surfaces and the tolerance or play that exists between the different bodies making up the device, and with every movement the tool makes there is unwanted friction which, over time, reduces the initial setting conditions, producing undesirable movement in the matching of parts.

In addition, a common problem of known embodiments, is the difficulty involved in coupling up the different bodies making up the device (a first body separate from the arm of the machine and a second one separate from the tool), since assembly is difficult when the machine operator, manoeuvring the arm from the cabin of the machine, has to match up the two parts or bodies of the device. This manoeuvre is made even harder when the tool is resting on uneven ground or if its slope is different from that of the ground under the machine on whose articulated arm the particular tool is to be coupled.

Similarly, in the embodiments known, master pins or dowel pins are used for joining up the body onto the end of the articulated arm of the machine, while said body and the tool are coupled via a third master pin and the other claws on the other body. Such configurations produce even more wear and tear of the parts as well as increasing the weight of the quick-coupling devices.

Lastly, the devices known are not suitable for coupling in different positions, so that if the tool is to be coupled the other way round, turned 180° with respect to a vertical axis, a second tool is required whose means of gripping are configured in reverse, and for this two different tools are needed, which therefore results in a greater investment in material.

It is also noted that there is no system whereby the machine operator can know if the bodies have been coupled together correctly and if the movable coupling elements are in the required position for the machine to function.

Explanation of the invention

To provide a solution to these problems, an explanation will be given of the quick and reversible coupling device for tools on machines, especially transport and lifting machines, earth-moving or digging machines, such as diggers, back-diggers or similar, said machines comprising an articulated arm at the end of which the tool

is coupled so that it cannot move.

The device is, in essence, characterized in that it comprises:

- an adaptor joined to said articulated arm via at least one master pin and, in one of its ends, made up of a base which is essentially flat and side walls, said adaptor also has fixing means, which move perpendicularly through said side walls; and
- means of coupling on the tool, which comprise of rigid hooks for receiving the ends of the master pin and side walls with perforations for receiving and holding, by locking, the movable fixing means of the adaptor,

the outer surfaces of the side walls of the adaptor and/or inner surfaces of the side walls of the coupling means having, at least partly, converging slopes suitable for gradually housing the adaptor in the coupling means of the tool, so that, in the coupling position, the base of the adaptor is in contact with a corresponding essentially flat-surfaced part of the tool, or coupling means, and the fixing means is introduced in the perforations of the side walls of the tool.

According to a preferred embodiment, the outer surface of the side walls of the adaptor have sloping guiding surfaces around the protruding ends of at least one master pin, said surfaces being cone-shaped with an imaginary axis being coincident with the longitudinal axis of the master pin.

In another preferred embodiment, the outer surfaces of the side walls of the adaptor have, at least partly, slopes which converge in the direction of coupling of the adaptor on the tool, insofar as the inner surfaces of the side walls of the coupling means have, at least partly, converging slopes which match the slopes of the outer surfaces of the adaptor, which produces a wedge or locking effect between the sloping surfaces of the adaptor and those of the coupling means in the coupling position.

In accordance with another characteristic of the invention, the coupling means of the tool comprise four rigid hooks located on the four ends of the side walls of the coupling means, positioned so that the master pin can be coupled with both the pair of front hooks and the pair of rear hooks, so that the tool can be coupled and fixed to the adaptor in two different positions, at an angle of 180° with respect to one another.

There are preferably two perforations on each side wall, opposite each other, and equidistant from the hooks on the same wall and axially aligned in the coupling position with the movable fixing means through the side walls of the adaptor, and the master pin being coupled in the pair of front hooks or in the pair of rear hooks,

due to the symmetrical positioning of the perforations, the movable fixing means of the adaptor, upon moving, are introduced in said perforations of the coupling means of the tool, the coupling means and the tool being joined in any of the possible coupling positions.

According to another characteristic of the invention, the perforations of the side walls of the tool have a section which gets smaller towards the outside, which matches with another section which gets smaller towards the outside of the fixing means to be housed inside of these during the coupling position.

In a preferred embodiment, the coupling means have in their font and rear parts means for housing the adaptor, which respectively have opposite sloping surfaces, and the end of the tool opposite to the master pin has at least one matching chamfer with a sloping surface so that, in the coupling position, the chamfer or chamfers can rest, without any play, on the sloping surfaces of the housing means located on the front or rear part of the coupling means, depending on the coupling position.

In accordance with another characteristic of the invention, at least one fixing means has a rod whose free end is visible from the outside, so that it can be determined visually whether the fixing element is housed inside the corresponding perforation.

Brief description of the drawings

The attached drawings illustrate, as a non-limitative example only, two forms of embodiment of the quick-coupling device for back-digger tools on machines, or similar ones to the object of the invention. In said drawings:

Fig. 1 is a perspective view of a first form of embodiment of the device, in which the adaptor and the tool are uncoupled;

Fig. 2 is a front elevational view of the device in Fig. 1, in which the adaptor and the tool are uncoupled;

Fig. 3 is a perspective view of the device in Fig. 1, in which the adaptor and the tool are coupled;

Fig. 4 consists of three front sectional views of three possible variations for one of the side walls of the coupling means for the device in Fig. 1;

Figs. 5 and 6 are both elevational side views of the two coupling positions of a shovel on the arm of a back-digger machine;

Fig. 7 is a perspective view of a second form of embodiment of the invention device, in which the adaptor and the tool are uncoupled;

Fig. 8 is also a perspective view of the device in Fig. 7, in which the adaptor and tool are in the process of being coupled;

Fig. 9 is a front, diagrammatical view of the adaptor and the coupling means according to the form of embodiment in the previous Figs. 7 and 8; and

Fig. 10 is a perspective view of the device in Fig. 7, in which the adaptor and the tool are coupled, the adaptor being in a position turned 180° with respect to the coupling position in the previous Figs. 7 and 8.

Detailed description of the drawings

Fig. 1 is a perspective view of a first form of embodiment of the device being the object of the invention, in which the adaptor 2 and the tool 3 are uncoupled.

The device comprises an adaptor 2 joined to the articulated arm 4 of the machine (represented in Fig. 5), via master pins 7 and 7', and is made up of a base 17 and side walls 10.

On the base 17 are movable fixing means 13, which together with the ends of the master pin 7 make the adaptor 2 couple securely to any tool 3 which has respective coupling means 1, whether this is a shovel, as in Fig.1, a bucket, hammers, clamps, grippers or pallet-fork lifters, etc.

As can be seen in Fig.1, the tool 3 does in fact have coupling means 1 which comprise side walls 9 whose ends are configured in the shape of rigid hooks 5, 5', 6 and 6', which can receive and grip, at least partly, the ends of the master pin 7.

Similarly, the side walls 9 have perforations, 8a and 8b, which can receive and hold, by locking, the movable fixing means 13 of the adaptor 2.

The positioning of the perforations 8a and 8b in the sides 9, and the positioning of the hooks 5, 5', 6 and 6' in the side walls 9, is longitudinally and transversally symmetrical so that, regardless of which hooks receive the master pin 7 of the adaptor 2, the movable means 13 of the adaptor 2 will be axially aligned with perforations 8a or 8b of the side walls 9 of the tool 3.

In Fig.1, the hooks 5 and 5', situated on the same end of the side walls 9, are about to receive the ends of the master pin 7. At this stage, the base 17 will sit on the corresponding surface 17' of the tool 3, and the fixing means 13 will remain axially aligned with the perforations 8b of the opposite end of the side walls 9. Similarly, if the tool 3 is turned 180° with respect to a vertical axis, the hooks 6 and 6' will receive the ends of the master pin 7, and the movable fixing means 13 of the adaptor 2 will remain axially aligned, this time, with the perforations 8a on the opposite end, closest to the hooks 5 and 5'.

Special attention should be paid to the fact that the master pin 7 used to join the adaptor 2 to the articulated arm 4, is the same one used to couple the tool 3 to the adaptor via the hooks 5, 5' or 6, 6', since in known embodiments, there is no case of the master pin 7 being shared in such a way, with different master pins being used for coupling the adaptor 2 to the tool 3 and for joining said adaptor 2 to the articulated arm 4 of the machine. In the invention device, the number of parts and the number of worn elements are reduced, which is an important improvement on the durability, weight and play of the devices known.

In Fig. 2 another characteristic of the invention device can be seen. In said figure, a front view of the coupling means 1 of the tool 3 is shown, in which it can be seen how the side walls 9, with respect to the direction of coupling of the adaptor 2, indicated by the arrow in Fig.2, have converging slopes, so that the upper ends of the walls 9 are further apart than those of their lower ends.

Such positioning greatly helps the coupling between the adaptor 2 and the tool 3, because the walls 9 of the tool 3 act as a guide for the side walls 10 of the adaptor 2 introduced inside the space within the two walls 9 of the tool 3. This greatly helps the coupling of the tool in situations where before it was very difficult to carry out such manoeuvre, for example, for the coupling of a tool 3 which is on uneven ground, and leaning with respect to the horizontal surface or to the surface on which the machine is standing.

In addition, the walls 10 of the adaptor 2 also have a slope which matches the slope of the walls 9 of the tool 3, producing an automatic fit between the adaptor 2 and the tool 3 during coupling and, once coupled, when pressure is transmitted to the tool 3, in this case the shovel, the pressure is not concentrated exclusively on the claws 5, 6 and the master pin 7, but is distributed between the walls 9 and 10 of both main bodies, producing a locking effect between its respective contact surfaces 9', 10', which greatly allows the pressure to be distributed over the device and lengthens its useful life, since wear and tear by friction, due to unnecessary play or concentrations of pressure on small surfaces, are reduced.

It should be pointed out that it is not necessary for the sides walls 10 and 9 to entirely comprise of converging slopes, as long as the inner surfaces 9' of the side walls 9 and the outer surfaces 10' of their side walls 10, are at least partly sloped.

Fig. 4a is thus a section view of a side wall 9 of the tool 3, according to the embodiment in Fig.1, in which the whole wall is sloping. Fig.4b shows a second variation in which only the inner surface 9' of the side wall 9 is sloping and, lastly, Fig. 4c shows a third form of embodiment in which only the part 9' of the inner sur-

face of the side wall 9 is sloping. This latter embodiment shows a side wall 9 with one or several ribs which run inwards, (this is towards the opposite side wall), in this case being the surface 9' of the ribs which shows the desired slope. Obviously, the outer surfaces 10' of the side walls 10 can also be configured in the same way as the inner surfaces of the tool 3, the variations explained above also being possible.

In Fig.3 the tool 3 is coupled to the adaptor 2, and the fixing means 13 of the adaptor, upon moving perpendicularly through the walls 10, can be introduced inside the perforations 8b of the side walls 9 of the tool 3. When this happens, the movements of the adaptor 2 transmitted through the articulated arm 4 of the machine (shown in Figs. 5 and 6) are transmitted to the tool 3 as if it were the same solid mass.

The perforations 8 can have various different forms although all must fit the shape of the fixing means 13 for insertion inside them. Both the perforations 8 and the fixing means 13 can thus have round or polygonal sections, and may also get smaller towards the outside, producing a wedge effect upon introducing the fixing means 13 in the perforations 8.

According to the embodiment in the drawings, the fixing means 13 can be moved by the action of a hydraulic system 12, which comprises at least two pistons 14 activated by an electric valve. In this way, the movement of the fixing means 13 can be controlled from the cabin of the machine or from any other place which has hydraulic-fluid or electrical communication with the hydraulic system 12.

This system will also have a retention valve for retaining the fixing means 13 inside the perforations 8 in case the hydraulic system loses pressure.

Obviously, the actuating mechanism of the fixing elements 13 can also be mechanical or even manual, and can incorporate safety devices to block the position of the fixing means 13 inside the perforations 8a or 8b.

As a safety element, the side walls 10 of the adaptor 2, at the opposite end to that of the master pin 7, are in the shape of a hook 18, whose open or eye section, in the coupling position, coincides with the hooks 5 and 5' or 6 and 6', depending on the coupling position, allowing a safety master pin to pass through them, joining the adaptor 2 and the tool 3. The hook configuration 18 will also, if necessary, mean that the hooks can act as lifting hooks, so that through their open end the adaptor can be suspended by a supporting cable.

Figs. 5 and 6 show the arm 4 of a back-digger machine or similar, in whose end the adaptor 2 is fixed respectively via the master pins 7 and 7', and in which the tool 3, in this case a shovel, is coupled to the adaptor, in two different positions,

turned 180° respectively with respect to one another and according to an imaginary axis of rotation 19.

A second form of embodiment of the quick-coupling device for tools on digger machines or similar is shown in Figs. 7, 8 and 9. In said figures, for simplification, the same numerical references have been used to indicate the same or similar components with respect to the description of the first form of embodiment in Figs. 1 to 6.

As can be seen in Fig. 7, the device comprises an adaptor 2, joined to the articulated arm of the machine via master pins 7 and 7', and is made up of a base 17 which is essentially flat and side walls 10. The ends of the master pin 7, located at the front end of the adaptor 2, are to be received and partially gripped by the front hooks 5, 5', or by the rear hooks 6, 6', of the coupling means 1 of the tool 3. In this way, and in the same way as in the previous embodiment, the device is reversible since the tool 3 can be coupled to the adaptor 2 using the coupling means 1, in two positions which are both turned 180° with respect to an imaginary vertical axis 19.

In Fig. 7, in which the adaptor 2 and the tool 3 are separate, it can also be seen that the coupling means 1 have housing means 21, 21' and 22, 22' respectively on their front and rear parts, for the adaptor 2. Said housing means consist in protruding extensions in the form of prismatic wedges. These prismatic wedges have sloping surfaces 24, those of the forward wedge being directly opposite those of the opposite end of the coupling means 1, with which said sloping surfaces of the front wedges 21, 21' are facing the corresponding sloping surfaces of the rear wedges 22 y 22'. While the adaptor 2 is being coupled, this characteristic makes the end of the adaptor 2 opposite to the master pin 7 rest on said sloping surfaces, and the adaptor 2 is forced to move towards its front end, so that the master pin 7 fits securely in the hooks of the locking means and the base 17 is in contact with a corresponding portion, with an essentially flat surface 17', of the tool 3 or the coupling means 1.

To improve the effect produced by the sloping surfaces of the wedges 21, 21' and 22, 22', the adaptor 2 has respective chamfers on each of its side walls 10, with slopes which match those of the wedges, so that in the coupling position the chamfers rest, without any play, on the sloping surfaces of the front or rear wedges, depending on the positioning of the coupling.

In Fig. 8, the ends of the master pin 7 are introduced in the hooks 5 and 5' and the rear wedges 22 and 22' have still not yet been supported by the chamfers 23 of the adaptor 2. In this figure, the movable fixing means 13 can be seen posi-

tioned at the same distance with respect to the master pins 7 and 7', while the perforations 8 of the side walls 9 of the coupling means 1 are at the distance with respect to the front hooks 5, 5' and rear hooks 6, 6'. In this way the fixing means 13 of the adaptor, upon being moved perpendicularly through the walls 10 of the adaptor, can be inserted inside the perforations 8 of the side walls 9 of the coupling means 1 to transmit the movements of the adaptor 2 to the tool 3, whatever the positioning of the coupling, in the same way as that of the first form of embodiment.

By having the same shape as the fixing means 13 getting smaller towards the outside, to match the section with the perforations 8, upon introducing the fixing means in the perforations, a wedge effect is produced, which forces the adaptor 2 to move towards the tool 3 and, due to the effect of the sloping surfaces of the wedges 22 and 22' (depending on the positioning of the coupling in Figs. 6 and 7) the adaptor 2 is also forced to move in a direction towards its front end, ensuring the correct coupling between itself and the tool 3.

As can be seen in Fig. 9, and different from the first form of embodiment, the inner surfaces of the walls 9 of the coupling means are not sloped at all and are perpendicular to the surface 17' of the tool 3. Nevertheless, in order to guide the coupling of the adaptor and to help introduce it between the walls 9 of the coupling means 1, the outer surface of the side walls 10 of the adaptor 2 have sloping guiding surfaces 10'. In the example given in the drawings, said guiding surfaces are positioned around the protruding ends of the master pins 7 and 7', and are cone shaped whose imaginary axis coincides with the longitudinal axis of the master pins. In this way, whatever the slope of the adaptor 2 with respect to the tool 3 during the coupling process, the guiding surfaces 10' which are in contact with the walls 9 of the coupling means converge in the direction of coupling and act as guides to ensure the adaptor 2 is correctly introduced between said walls 9.

In Fig. 10, in which the adaptor 2 is coupled to the tool 3 via the coupling means 1, it can be seen that the inventor also provided for the adaptor 2 to have at least one perforation 25, positioned level with the rear master pin 7', and in one of the side walls 10, which communicates the upper surface of said wall 10 with the perforation for housing the master pin 7'. This master pin 7' has its own respective perforations which are axially aligned with the perforations 25, enabling the end of the safety master pin, introduced through the perforations 25 of the adaptor 2, to be housed. In this way, the safety master pin prevents the master pin 7' from moving, securing its position in the adaptor 2, which joins the adaptor to the mechanical arm 4 of the machine.

Also in Fig. 10, the adaptor 2 is coupled to the tool 3 in a position which is turned 180° with respect to the coupling position shown in the previous Figs. 7 and 8, without needing to change or replace the tool 3 with another whose coupling means can be adjusted to the new coupling positioning. Using the same adaptor 2 and the same tool 3, the latter can be coupled in different positions, greatly improving what other known devices can offer.